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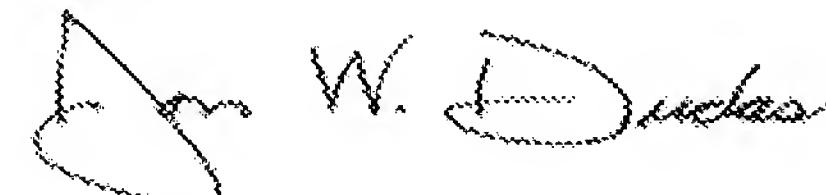
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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

### INVENTOR(S)

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Additional inventors are being named on the \_\_\_\_\_ separately numbered sheets attached hereto

### TITLE OF THE INVENTION (280 characters max)

METHOD AND DEVICE FOR DETECTING PROLONGED CARDIAC REPOLARIZATION TO DIAGNOSE  
TRANSMURAL MYOCARDIAL ISCHEMIA

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### ENCLOSED APPLICATION PARTS (check all that apply)

Specification Number of Pages

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Acknowledgement Postcard

Application Data Sheet. See 37 CFR 1.76

### METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)

Applicant claims small entity status. See 37 CFR 1.27.

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Yes, the name of the U.S. Government agency and the Government contract number are: \_\_\_\_\_

Respectfully submitted,

SIGNATURE

Date

2-11-04

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45,791

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## PROVISIONAL PATENT APPLICATION

# METHOD AND DEVICE FOR DETECTING PROLONGED CARDIAC REPOLARIZATION TO DIAGNOSE TRANSMURAL MYOCARDIAL ISCHEMIA

## BACKGROUND OF THE INVENTION

### 1. Technical Field

The present invention relates to a device and method for detecting prolongation of myocardial repolarization as a novel marker of transmural ischemia. More specifically, the present invention provides a method and device to detect prolonged repolarization using electrocardiographic and electrophysiological tools and measurements to make the diagnosis of transmural ischemia.

### 2. Description of the Related Art

Many cardiac conditions can be detected by measuring and recording

electrical signals from the heart. When displayed, the electrical signals form various patterns, which can be visually recognized. Generally, the electrical signal recorded from the ventricle or the atrium of the heart has different components: a sharper high frequency component that represents "depolarization" of the heart muscle and slower frequencies that represent the "repolarization" component. Electrocardiograms are routinely used for diagnosis and therapy of various cardiac conditions, based on certain patterns of abnormalities seen in the depolarization or the repolarization components of the ECG. However, the electrocardiograms measured and used in the usually described format have significant limitations in detecting and identifying cardiac ischemia. Transmural ischemia is currently identified electrocardiographically by analyzing the QRS, ST and T-waves morphology. However, the changes in these electrocardiographic signals are neither sensitive nor specific in detecting transmural ischemia.<sup>1</sup>

Additionally, the waveforms are often not able to detect the occurrence of transmural ischemia, because depending upon the timing of the ECG, classical changes, such as ST segment elevation or Q waves, may be absent. As a result, many individuals may be experiencing transmural ischemia, but are never diagnosed. It would therefore be beneficial to develop a method and device for detecting the occurrence of transmural ischemia by measuring the duration of myocardial repolarization.

## **DESCRIPTION OF THE INVENTION**

Generally, the present invention provides a method and device for the detection of prolonged myocardial repolarization that, as we have shown, can be used to diagnose even brief episodes of transmural ischemia (<2minutes).

More specifically, the present invention provides a device to measure the duration of myocardial repolarization during transmural ischemia or infarction.

The device of the present invention can be any device, be it automated or manual, that is capable of accurately measuring the QT interval and other indices of measuring the duration of myocardial repolarization. Classical cardiology and physiology teachings state that the metabolic changes that occur in ischemic hearts promote the *abbreviation* of the myocardial repolarization and the QT interval.<sup>2, 3</sup> On the contrary, the current invention detects a paradoxical prolongation of the QT interval and duration of myocardial repolarization as a marker of transmural ischemia. It has been determined by Applicants that prolongation of the QTc and duration of myocardial repolarization occurs prior to other changes during acute transmural ischemia. The prolongation of the QT interval is one of the first detectable symptoms of transmural ischemia. It is also the most consistent finding (occurring in 100% of patients).

The corrected QT interval on the surface electrocardiogram is the

**earliest and most consistent** (100%) finding during transmural ischemia induced by balloon occlusion during percutaneous coronary angioplasty. This should be contrasted with the fact that in the study, substantially fewer numbers of patients developed chest pain (33%) or ST segment elevation (50%), the classical electrocardiographic feature of transmural myocardial ischemia.

The QT interval is the measure of repolarization of the ventricular electrical signal on the surface electrocardiogram. In addition, other methods to assess repolarization include intracardiac electrograms, assessing activation recovery intervals and monophasic action potentials.

During a myocardial infarction intermittent occlusion can occur, resulting in cyclical flow, resulting in the absence of classical ECG changes. Any technology incorporated into any external (wearable monitor), internal (implantable) or intracardiac devices (using QT/QTc intervals, activation recovery intervals, monophasic action potential durations) can be used to accurately measure repolarization times and thus enhance the sensitivity in detecting transmural myocardial ischemia.<sup>4,5</sup>

Additionally, prolongation of the repolarization time after balloon inflation during percutaneous coronary intervention may be used to determine the status of the microvasculature and myocardial perfusion i.e. if there is a

long delay in return of the QT to baseline, it may indicate occurrence of embolization of atherosclerotic or thrombotic material downstream from the balloon inflation and certain therapeutic measures can therefore be instituted.

More specifically, the device of the present invention functions by reviewing the QT interval of the ECG and various indices of myocardial repolarization. Then the device quantitates the QT interval or duration of myocardial repolarization and compares the results with a standard to determine if there is deviation from the standard and tracks changes over time. Specifically, if the device detects a prolongation of the QT interval it is indicative of transmural ischemia.

The present invention can be included in a portable device that is worn by an individual. The device can be worn by an individual in order to detect ischemia. Alternatively, the device can be located at a hospital or doctor's office. It can also be incorporated into a device implanted in the body. The device can be used to detect ischemia in patient's presenting with or without symptoms. It can also be used in monitoring high risk patients for early transmural ischemia.

Throughout this application, author and year, and patents, by number, reference various publications, including United States patents. Full citations for the publications are listed below. The disclosures of these publications

and patents in their entireties are hereby incorporated by reference into this application in order to more fully describe the state of the art to which this invention pertains.

The invention has been described in an illustrative manner, and it is to be understood that the terminology that has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the described invention, the invention may be practiced otherwise than as specifically described.

References:

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